The Marin Countywide Plan

Environmental Hazards Element Technical Report #1
Flood Hazards in Marin County

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EXECUTIVE SUMMARY

The Marin Countywide Plan Environmental Hazards Element, first adopted in 1977, must be updated to include the findings of recent flood studies and State of California requirements for hazards planning. This technical report examines existing flood hazard conditions and proposes amendments to the Countywide Plan Environmental Hazards to address these conditions

The risk of serious flooding threatens a number of Marin communities located in the path of watercourses, near the Pacific Coast, and along the San Francisco Bay. Considerable Marin County development has occurred in or near floodplains where storm water runoff, tidal action, and high surf regularly cause flooding. Storm-related and coastal flooding has occurred frequently in Marin; the County experienced major flooding from these sources in 1952, 1955, 1958, 1967, 1970, 1973, 1975, 1978, 1982, 1983, and 1986.

In addition to current flood problems, Marin communities may face increased flooding caused by a projected rise in the water level of the Ocean and the Bay. Some Marin communities also face inundation from a failure at one of Marin's eight dams following a major earthquake.

The risk of flooding in Marin is a costly problem for property owners and local governments. The public and private cost of flooding in Marin County reached an estimated $100 million in 1982 alone. Flooding often affects property owners and local governments uninsured against flood loss; just $10 million out of the over $100 million in flood damage between 1977 and 1986 involved insured property owners.

Marin County government agencies engage in a number of flood protection measures. The Marin County Department of Emergency Services has prepared a County Multihazard Plan (1988) which outlines actions to insure effective disaster response. The Marin County Flood Control and Conservation District coordinates flood control construction projects funded and approved by the eight Flood Control Zones in the County. The Marin County Code includes a number of sections restricting development in the floodplain, including: Bayfront Conservation Zoning, Floodplain Zoning, Tidelands Zoning, and Floodplain Management Regulations.

Modifications to the Environmental Hazards Element proposed in this technical report focus on incorporating the findings of recent studies and on supporting current flood control activities. Suggested revisions to this element include changes to the wording of existing policies and the addition of new policies.

These policy changes would: (1) provide support for recently approved floodplain management regulations; (2) expand the application of floodplain zoning; (3) provide public information about the risk of dam failure flooding; and (4) recommend additional County actions to monitor the sea level rise and protect Marin citizens against flooding caused by increases in the water level of the Bay and Ocean.

I. PURPOSE

The current Environmental Hazards Element, adopted in 1977, has not been revised to include recent flood hazard studies and legislation. This technical report reviews current legal authority for flood hazard planning, flood problems in Marin County, and current flood protection measures. The report also suggests revisions to the Countywide Plan Environmental Hazards Element which will improve conformance with existing environmental and programmatic conditions.

II. AUTHORITY

The authority under California law for local flood hazard planning includes the California State Constitution, the California Government Code, and the California State Dam Safety Act of 1972. Under Federal law, the National Flood Insurance Act of 1968, and the Flood Disaster Protection Act of 1973 delegate specific authority to local governments to apply and enforce Federal standards in flood control planning.

The California State Constitution, Article II, Section 7, delegates the responsibility for adopting floodplain zoning to local governments. Such zoning regulations must be based on local policy documents, including the general plan.

The California Government Code requires cities and counties to protect the public against unreasonable risk due to flooding (Sections 65302(d) and (9), 1980) through the general plan. The State Government Code authorizes localities to require flood studies for parcel and final subdivision map applications (Section 66434.2, 1985).

The Government Code also obligates governments to consider the effects of flooding from tsunami, seiche, and dam failure in addition to storm runoff and tidal activity in the safety element of the general plan (Section 65302, 1980).

The California Dam Safety Act of 1972 (SB 896) requires local governments to map areas subject to inundation from dam failure. Pursuant to the Act, State Water Code Section 6002 authorizes the State Division of Dam Safety to permit, inspect, and require mapping of all dams over fifteen feet in height and over 1,500 acre-feet of capacity. The Dam Safety Act also obligates local governments to notify property owners within dam inundation areas regarding the possibility of a dam failure.

The National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 authorize the Federal Emergency Management Agency to conduct Flood Insurance Studies and establish insurance rates for properties falling within identified flood zones. These rates create economic incentives for sound floodplain management and land use planning. The reports and maps provided by the Federal Emergency

Management Agency identify the 100-year floodplain (the land area expected to flood once every 100 years), and base flood elevations (the anticipated level of water in the 100-year flood). Marin County building officials use these materials in evaluating development applications and flood control projects.

IV. FLOOD PROBLEMS IN MARIN COUNTY

Flooding in Marin County poses a serious threat to public health and safety, property, commerce, and governmental services. The threat of flooding necessitates extraordinary public expenditures for flood protection and relief. Damage from flooding in the years 1977 through 1986 caused $10.8 million insured damage in the County as whole, and $2.9 million in the County unincorporated area. These figures are far below actual public and private damage totals because they only include damage to properties insured under the National Flood Insurance Program. The estimated cost of public and private damage in Marin County exceeded $100 million in 1982, $9 million in 1983, and $8 million in 1986 (Marin Independent Journal, February 17, 1986 and March 14, 1983). The amount of flood insurance claim payments and number of claims by city are shown in Table 1 and Table 2.

Table 1. Total Flood Damage in Marin County Measured in Flood Insurance Claim Payments: 1977-1986

Year	Cases	Amount
1977	3	$ 11,445
1978	24	106,065
1979	11	45,363
1980	61	154,586
1981	21	21,668
1982	635	5,040,945
1983	466	4,144,677
1984	3	2,969
1985	2	3,210
1986	196	1,276,460
Total	1422	$10,807,388

Table 2. Flood Damage Measured in Flood Insurance Claim Payments in Marin County: 1977-1986

Jurisdiction	Year	Payments	Amount Paid
Belvedere	1982	21	$131,451
	1983	25	$243,738
	TOTAL	46	$375,189
Corte Madera	1977	1	$3,294
	1981	2	$2,680
	1982	57	$629,229
	1983	9	$85,000
	1984	2	$2,534
	1986	66	$417,252
	TOTAL	137	$1,139,989
Fairfax	1978	1	$3,000
	1980	2	$3,023
	1981	2	$814
	1982	12	$19,478
	1983	2	$22,711
	TOTAL	19	$49,026
Larkspur	1978	2	$2,973
	1981	2	$1,119
	1982	15	$128,396
	1983	26	$208,759
	TOTAL	45	$341,247

Table 2 (continued)

Mill Valley	1977	2	$8,151
	1978	5	$10,907
	1979	7	$16,803
	1980	7	$24,385
	1982	49	$177,771
	1983	13	$84,524
	TOTAL	83	$322,541
Novato	1980	23	$37,805
	1982	162	$1,308,110
	1983	9	$8,910
	TOTAL	194	$1,354,825
Ross	1980	2	$1,068
	1981	1	$75
	1982	64	$779,325
	TOTAL	67	$780,468
San Anselmo	1978	2	$1,998
	1979	1	$487
	1980	1	$1,075
	1982	52	$401,086
	TOTAL	56	$404,646
San Rafael	1978	4	$20,769
	1979	1	$2,817
	1980	8	$44,704
	1981	4	$4,919
	1982	82	$814,756
	1983	181	$1,526,642
	1986	77	$608,904
	TOTAL	357	$3,023,511

Table 2 (continued)

Sausalito	1978	2	$1,329
	1980	1	$401
	1982	2	$1,323
	1983	5	$20,690
	TOTAL	10	$23,743
Tiburon	1980	1	$351
	1981	2	$1,662
	1982	5	$32,921
	1983	4	$12,431
	TOTAL	12	$47,365
Unincorporated	1978	8	$65,089
	1979	2	$5,256
	1980	16	$41,774
	1981	8	$10,399
	1982	114	$617,099
	1983	192	$1,931,272
	1984	1	$435
	1985	2	$3,210
	1986	53	$250,304
	TOTAL	396	$2,944,838
COUNTY TOTAL		**1422**	**$10,807,388**

Risks to the community from flooding occur primarily from development activity in the floodplain: land areas which may be inundated from storm runoff, tidal action, or high surf. Land uses located in the floodplain may be destroyed or severely damaged during a flood. Development and other obstructions in the floodplain also raise the height and erosive velocity of flood waters, spreading flood damage over a greater area.

The hazards associated with flooding differ according to the presence of development and other encroachments in the floodplain. The Federal Emergency Management Agency identifies two portions of a floodplain: the floodway and the flood fringe. Floodways are watercourses which must be kept free of obstructions so that flood

heights and destructive power do not increase. Floodways include streams, low-lying areas which fill with fast-moving storm waters, and coastal areas subject to powerful wave or tidal action. Flat expanses of land which fill with slower waters spreading out from the floodway are known as the flood fringe. Flood fringes and floodways have been developed in Marin, necessitating costly public works projects and rigorous construction standards to minimize disaster losses. The distinction between floodways and flood fringes is shown in Figure 1.

Marin floods originate from watercourses, reservoirs, and coastal waters. Marin waterways regularly swell with storm water runoff and inundate developed areas, and flooding both inland and coastal communities. Several populated areas in the County would be flooded in the event of dam failure following a major earthquake. High tides combined with storm water runoff create floods in low-land bayfront and Pacific Coast communities. Flood hazards along the Marin coast may increase over time due to the projected increase in the water level of the Pacific Ocean and the San Francisco Bay.

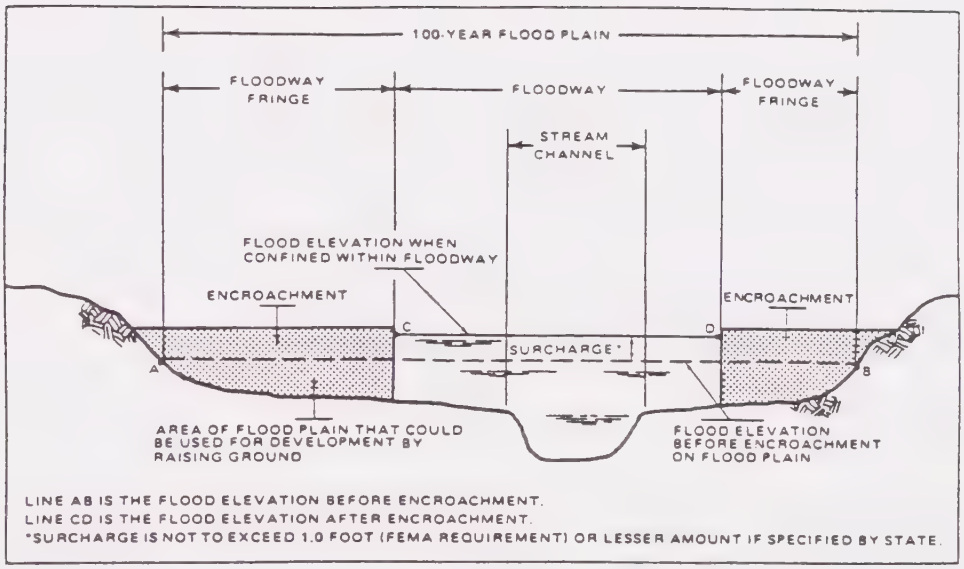
A. WATERCOURSE FLOODS

Watercourse floods in Marin can develop from storm water runoff within 24 hours after the beginning of a storm. Rainfall in Marin is heavy and rainy season flooding frequent. Major floods since 1950 have occurred in 1952, 1955, 1958, 1967, 1970, 1973, 1975, 1978, 1982, 1983 and 1986. Flood-producing storms generally occur between December and March and they last three to four days.

Poor soil drainage increases surface water runoff in a storm and may cause flooding along hillsides as runoff rushes towards valleys and watercourses. Inadequate capacity may cause flash flooding where watercourses rise quickly in heavy rainstorms and spill flood waters into developed areas. Flash flooding may also occur as storm runoff changes dry gullies and even local roads into torrents of water. As flood levels rise approaching the bay and ocean, they may spill out over lowering areas or meet up against high tidal waters flooding coastal communities. Storm runoff may also liquify soil, creating highly destructive mud and landslides (these are covered in more detail under geologic hazards), as is often associated with flooding in Marin.

Major watercourses posing flood problems in unincorporated Marin County include Arroyo San Jose, Corte Madera Creek, Corte Madera del Presidio Creek, Coyote Creek, Crest Marin Creek, Eskoot Creek, Lagunitas Creek, Miller Creek, Novato Creek, Olema Creek, Reed Creek, San Antonio Creek Sutton-Manor Creek, Tennessee Creek, Walker Creek, and their tributaries. In addition to major watercourses, the County contains a number of smaller streams and watercourses which have caused considerable damage following heavy storms.

Figure 1. Floodways and Flood Fringes



Watercourse flooding occurred throughout Marin County in 1982, 1983, and 1986. Total damage from storms in these years ranged from $9 million in 1983 and 1986 to $100 million in 1982 (Marin Independent Journal, March 4, 1983, February 17, 1986). The extent of damage from the 1982 floods was severe, providing an impetus to improve flood control systems and establish floodplain management regulations.

"The great storm" of 1982 caused highly destructive flooding in Marin. Damage from flooding and mudslides caused four deaths, destroyed 100 homes and damaged 2000, closed hundreds of businesses, and forced the evacuation of more than 2000 people. Flood waters and mudslides closed Highways 101 and 37, major thoroughfares, and city streets. Blocked roads completely isolated entire Marin communities for days. Sheetflow flooding and mudslides damaged many homes in hilly areas. Overflowing streams turned streets in San Rafael, San Anselmo, Fairfax, Ross, and Kentfield into raging rivers that filled business districts with as much as five feet of water. Flood waters swept away automobiles and furniture in urban areas and livestock in West Marin. County officials called in the National Guard to evacuate flood victims, control flood waters, and help repair the destruction caused by the flood. Marin County was declared both a State and Federal disaster area after the 1982 floods, and financial assistance was made available to flood victims, many of whom were not insured for flood loss. The storm cost an estimated $100 million in damage, $90 million of which affected uninsured property owners and local governments.

B. DAM INUNDATION

Dams in Marin County lie near the San Andreas Fault and could rupture or spill water in the event of an earthquake or after a storm, causing flash flooding in populated areas. The severity of flooding would depend on the size of the quake, the amount of damage to dams, or the volume of water overtopping dam walls. A large enough quake could completely rupture dams, releasing most of the retained reservoir waters. A smaller quake, while doing little structural damage to the dam itself, could generate a seiche effect causing water to spill over dams similar to the way water spills out of a bowl when shaken. Seiche waves are generally small (less than a foot), but in shallow or constricted areas, wave run-up can be as great as 20 or 30 feet, overtopping dams and reservoirs and flooding downstream development. Heavy rains could cause overtopping as well as structural failure where water pressure could break apart weak areas in a dam wall.

Dams in the County are of two types: large facilities under public control, and small private facilities. The larger dams and reservoirs posing flood hazards include: Alpine Lake, Bon Tempe Dam, Lagunitas Lake, Kent Lake (Peters Dam), Phoenix Lake, Nicasio Reservoir, Novato Creek Dam (Stafford Lake), and Soulajule Reservoir Dam. These dams come under the control of the State Division of Dam Safety.

With funding from a State grant, Marin water districts mapped the areas subject to inundation from dam failure at seven reservoirs: Alpine, Bon Tempe, Lagunitas, Peters (Kent Lake), Nicasio, Novato Creek (Stafford Lake) and Phoenix Lake. The mapping project was very expensive, and because Soulajule dam was built in 1979 after the State funding period expired, Soulajule inundation areas have not been mapped. A dam failure at Soulajule would inundate rural land and a Pacific Bell receiving site, endangering few populated areas. Mapped areas subject to inundation from dam failure include parts of Corte Madera, Larkspur, Inverness, Kentfield, Novato, Point Reyes Station, Ross, and Sir Francis Drake Boulevard from Lagunitas to Tomales Bay. The areas shown in the Dam Inundation Maps in Appendix 1 represent a worst case dam failure.

The key map in Appendix 1 indicates the location of large publicly maintained dams. The volume of water contained in these reservoirs is shown in Table 3.

Table 3. Marin County Dams

Public Dams	Water Capacity (in acre-feet)	Responsible Water District
1. Alpine Dam	8,900	Marin Municipal Water District
2. Bon Tempe Dam	4,300	Marin Municipal Water District
3. Lagunitas Lake	390	Marin Municipal Water District
4. Peters Dam	32,900	Marin Municipal Water District
5. Phoenix Dam	527	Marin Municipal Water District
6. Nicasio Reservoir	10,300	Marin Municipal Water District
7. Novato Creek Dam	4,230	North Marin Water District
8. Soulajule Reservoir	10,300	Marin Municipal Water District

Source: Marin County Planning Department, 1987.

A number of small dams on private property exist in the County, primarily serving agricultural uses. Each of these dams require permits from the Department of Public Works under Marin County Code Title 11.04, Dam Construction and Repair. Areas subject to inundation from these dams have not been mapped.

Dam safety is addressed both by the State Division of Dam Safety and the Marin County Department of Public Works. The State Division of Dam Safety issues permits and conducts safety inspections for dams over 25 feet in height and retaining over 50

acre-feet of water. The nine large dams in Marin County fall under State jurisdiction. The County Department of Public Works, under Title 11.04, permits smaller private dams.

C. COASTAL WATER FLOODS: OCEAN AND BAY

The simultaneous occurrence of very high tides, large waves, storm swells, and rain during the winter may cause flooding along the Marin coast. In addition, tsunami (sea waves generated from oceanic earthquakes, marine landslides, and volcanic eruptions) create potentially destructive natural water waves.

Storm centers from the southwest produce the type of storm pattern most commonly responsible for coastal water flooding in Marin. Strong southern winds accompanied by high tides and heavy surf threaten Pacific Coast and bayfront communities. In some instances, high tides back up river flows, causing flooding at river mouths.

The Pacific Coast communities most threatened by coastal water floods include Bolinas and Stinson Beach. Along the San Francisco Bay, areas near Novato Creek, the Petaluma River, Point San Quentin, San Pablo Bay, San Pedro Peninsula, and Sausalito face significant flooding.

Severe coastal flooding occurred in 1978 and 1983 when high tides, strong winds and large storm waves severely damaged property in several Marin communities.

In January 1978, a series of storms from a more southerly direction than usual damaged normally protected ocean beaches. Waves overtopped and undermined jetties and breakwater barriers. Direct wave damage occurred to many beachfront homes in Stinson Beach. Wave erosion coupled with saturated ground conditions damaged the foundations of homes in Bolinas along the ocean bluff. Seawalls and temporary barriers failed to protect property from wave damage.

In February 1983, a strong southern storm coupled with powerful winds and high tides flooded homes and businesses in San Rafael, Santa Venetia, and Stinson Beach. Pounding ocean waves destroyed five homes and damaged many others in the Seadrift area of Stinson Beach. High tidal waters poured over levees in San Rafael, flooding portions of East San Rafael and the Canal area. High tides also rushed over levees in Santa Venetia flooding more than 300 homes. Marin County was declared a disaster area following the 1983 storm.

Coastal floods from tsunami occur rarely along the Pacific Coast or in the San Francisco Bay. The most recent tsunami to cause any significant damage was in 1964.

The 1964 tsunami caused roughly $275,000 in damage to yacht harbors in San Rafael and Sausalito along the Bay.

D. RISE IN THE SEA WATER LEVEL

The projected rise in the water level of the San Francisco Bay poses a flood hazard not addressed in the 1982 Countywide Plan. In a 1985 report prepared by Philip Williams and Associates, "An Overview of the Impact of Accelerated Sea Level Rise on the San Francisco Bay", the Bay Conservation and Development Commission (BCDC) projected that a global climate change caused by the accumulation of "greenhouse" gases in the atmosphere (carbon dioxide, methane, and chlorofluorocarbons) will raise the temperature of the earth's atmosphere. BCDC claimed that this global warming trend could melt polar ice caps, accelerating the rise in sea level from the present rate of one-half foot per century to an average of 4 to 8 feet in the next century.

Such a rise could affect Marin County in several ways. Tidal circulation would change and wave action would increase. Drainage would be impeded and ground water could be contaminated. Salt marsh, brackish marsh, and existing seasonal wetland areas would be reduced.

Planners at BCDC recommend that local governments take into consideration the rise in sea level in their project development, land use planning, and land use control regulatory process. Specifically, they ask local governments to study the effects of a sea level change in development project review and to apply engineering design standards to approved bayfront projects. The Commission proposes design standards and project review criteria in a report entitled, "Sea Level Rise: Predictions and Implications for San Francisco Bay", San Francisco, December 1987. The Commission also asks that localities monitor the rise in sea level for their shoreline and identify areas at risk of increased flooding.

IV. FLOOD PROTECTION MEASURES

The Marin County Departments of Emergency Services, Public Works and Planning, and the Marin County Flood Control District implement a variety of flood protection measures. These measures include a disaster plan, major flood control projects, and Marin County Code sections pertaining to flood hazards. The County also relies on FEMA maps and studies for its flood control programs.

The County's flood protection measures serve several objectives. Protection for the life and property of Marin residents against flood risks is the most basic objective, underlying all County flood protection activities. The County supports the expansion and improvement of flood control projects in order to protect existing developed

communities from coastal and watercourse flooding. The County encourages regulatory methods of flood prevention for newly developing areas rather supporting the construction of costly flood control projects to meet a number of objectives:

1. Ensure that those who occupy hazard areas assume responsibility for actions which affect the general public;

2. Reduce the need for spending limited public resources on costly flood control projects that may not equally benefit all those who pay;

3. Reduce the need for rescue and relief efforts in the event of a disaster;

4. Reduce losses incurred by those inadequately protected against inevitable flooding, and;

5. Prevent avoidable risks to life and property by restricting encroachments into waterways and portions of the floodplain which are necessary for safely carrying floodwaters.

County flood protection measures also bring the County into conformance with State and Federal requirements for planning and protecting the public against the hazards associated with flooding.

A. COUNTY DISASTER PLANNING

The Marin County Department of Emergency Services has prepared a comprehensive emergency response plan for the county, called the Marin Multihazard Plan. The Multihazard Plan addresses Marin County's response to extraordinary emergency situations and focuses on large-scale disasters posing major threats to life and property. Designated Marin County officials activate the plan when declaring a State of Emergency. Emergency operations are coordinated from a central Emergency Operations Center (EOC), located in the County Administration Building. The Emergency Operations Center first became fully operational in time for the disastrous 1982 flood.

The plan outlines emergency conditions, agencies responsible for responding to emergencies, hazard mitigation measures, mutual aid agreements, and checklists for actions required in the event of an emergency.

B. THE MARIN COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

The County Flood Control and Water Conservation District was established in 1953 by the State Legislature through the Marin County Flood Control and Water Conservation District Act (Chapter 68 of the Appendix the California Water Code). Boundaries of the District coincide with county boundaries, with the exception that the Town of Corte Madera is not part of the District. The Marin County Board of Supervisors sits as the Board of Supervisors of the Flood Control District, and the District is operated in coordination with the County Department of Public Works. The District administers flood control projects and oversees revenue collection in each of eight active Flood Control Zones in Marin. Flood Control staff work for the County of Marin, but charge their time to the appropriate Flood Zones.

Marin County Flood Control Zones are located in populated areas. Each Zone has an Advisory Board which recommends flood control projects and funding to the Board of Supervisors. Flood Control Zones raise money through property taxes and assessment overrides. The Zones fund their own control projects, and contribute funds to the central administration of the Flood Control District. The Zones vary considerably in size, financial resources, and hazard severity. Funds raised within a Flood Control Zone can only be spent within that zone. The Flood Control District has problems addressing all County flood control needs under a system characterized by revenue surpluses in some Zones, inadequate financing for flood control projects in others, and very little money for areas outside the system of Flood Control Zones altogether. Flood Control Zones in the County are shown in Figure 2.

The Flood Control District has administered a number of flood protection measures in County Flood Control Zones. Projects include the purchase of land to reestablish the floodplain, flood proofing of property by raising flood prone buildings and making them watertight, construction of berms and retaining walls, and floodplain zoning. Other flood control activities undertaken in flood zones include the construction of physical facilities such as stream channels, pump stations, levees, and riprapping.

The eight flood control zones in Marin are:

> *Flood Control Zone #l (Novato)* - This Zone encompasses the entire watershed tributary to Novato Creek which includes all of the City of Novato plus a substantial amount of unincorporated area around Novato. In November of 1984, the voters of this Zone approved a four year, $9 million project to reduce flooding from Novato Creek and its tributaries. The Zone also periodically dredges watercourses and began an annual debris removal program in 1983 with the Marin Conservation Corps.

Flood Control Zone #3 (Richardson Bay) - Flood Control Zone #3 includes the area tributary to the upper end of the Richardson Bay, all of Mill Valley, plus unincorporated areas such as Marin City, Tamalpais Valley, Homestead Valley, Alto-Sutton Manor area, and portions of the Strawberry Peninsula. The Zone has built pump stations at Cardinal Road, and Shoreline Highway at Coyote Creek. The Zone has also adopted a plan for constructing major flood control works over several years.

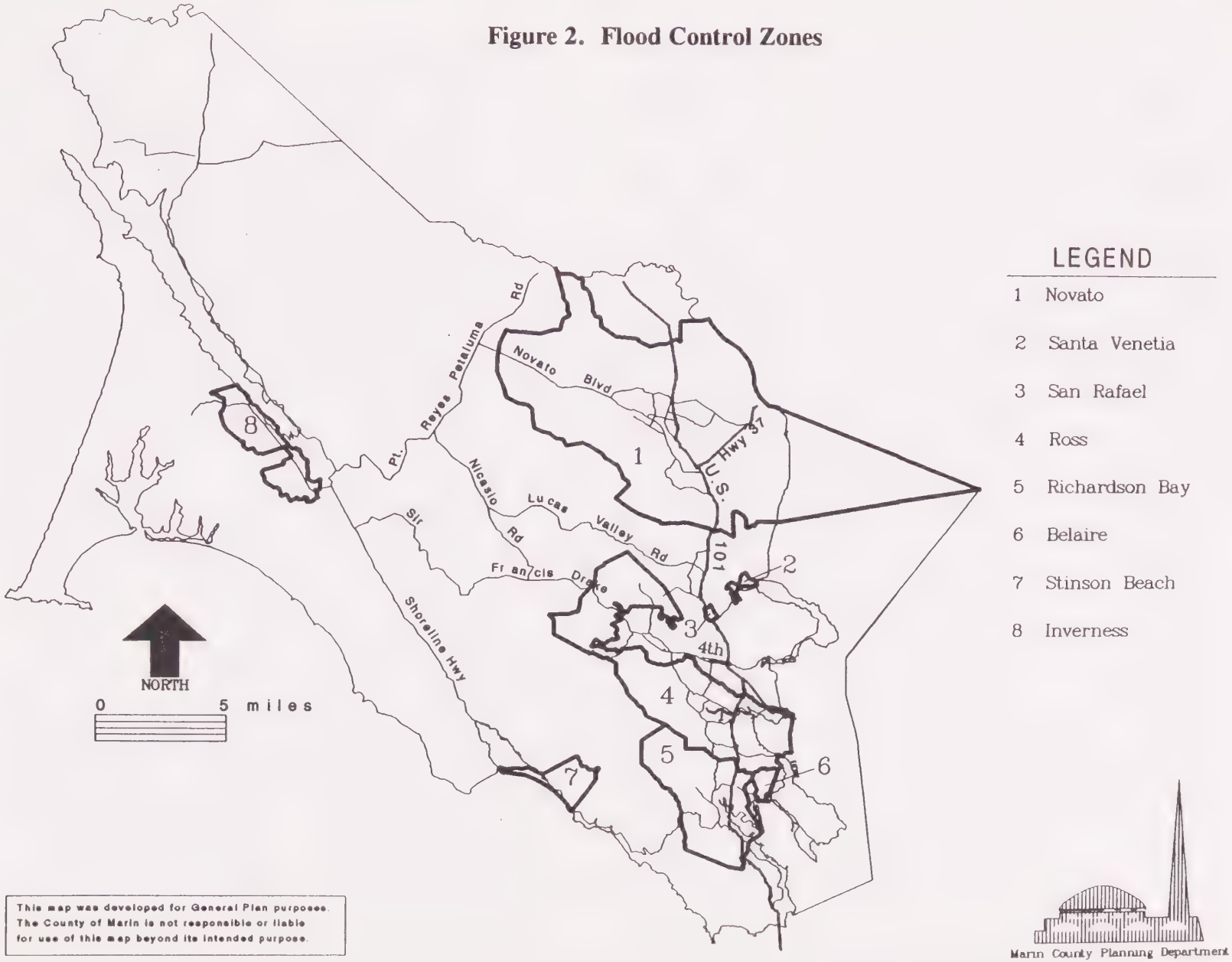
Flood Control Zone #4 (Bel Air) - This small Zone is located off Tiburon Boulevard, recently annexed to the City of Tiburon. The Zone maintains a major storm water pump station, cleans existing drainage ditches, and plans to replace culverts under Highway 131 and construct an additional storm water pump station.

Flood Control Zone #5 (Stinson Beach) - Flood Zone 5 includes all of the area tributary to Eskoot Creek which runs through Stinson Beach. The Zone has a very limited budget and present policy includes maintenance operations only. Periodic inspection of the creek and required enforcement of County code regarding debris and/or illegal structures occurs under the jurisdiction of the Flood Control District.

Flood Control Zone #6 (Rafael Meadows) - This Zone, located across the highway from the Marin County Civic Center, lies within the City of San Rafael. While the City of San Rafael performs all maintenance within the district, residents and the City kept the district active as a potential source of revenue for future projects.

Flood Control Zone #7 (Santa Venetia) - Flood Zone 7, located east of the Marin County Civic Center, faces a number of ongoing problems related to its location in a floodplain and atop bay mud which is subsiding at the rate of one inch per year. The area was particularly hard hit during the winters of 1982 and 1983, affected both by storm water runoff and unusually high tides. The Zone began reinforcing the existing levee system after the 1982-83 floods with a loan from Flood Control Zone #4. The Zone built a bypass system to take runoff from the surrounding hillsides and carry it into Las Gallinas Creek around local drainage systems, and a series of stormwater pump stations to lift storm water out of the area. The Flood Control District presently maintains internal drainage systems, perimeter levees and five storm water pump stations.

Figure 2. Flood Control Zones



Flood Control Zone #9 (Ross Valley) - This Zone encompasses all of the Ross Valley with the exception of San Anselmo and Fairfax and is currently acting under court order to complete the Corte Madera Creek project. The project, though 70% completed, has been stalled for a number of years due to public opposition, litigation and funding shortfalls.

Flood Control Zone #10 (Inverness Ridge) - This Zone formed after a disastrous January 1982 storm. The Zone collected taxes and cleaned and restored local creek channels. It received a Coastal Conservancy grant for funding creek work in the Haggarty Gulch and Fish Hatchery Creeks. Taxes are no longer collected for this zone.

C. STREAMSIDE CONSERVATION POLICY

The Countywide Plan Environmental Quality Element establishes a Streamside and Creekside Conservation Zone Policy. The Streamside Conservation Zone consists of a 50 to 100 foot buffer along all natural watercourses and riparian systems. The County Planning Department restricts structural improvements within the Streamside Conservation Zone for a number of reasons, such as preventing watercourse obstructions which increase flood hazards.

D. MARIN COUNTY CODE TITLE 22 - ZONING

1. Floodplain Zoning

Marin County Code Title 22, Sections 22.94 and 22.95, adopted in 1979, establish two flood overlay zones. The Primary Flood District (F-1) applies to lands in a primary floodway zone, defined as a channel required for the passage of flood waters. The Secondary Floodway District (F-2) applies to land between the Primary Floodway and the edge of the floodplain.

The F-1 District addresses the serious dangers associated with blockage in the floodway channel. The F-1 District prohibits the construction of buildings, structures, dredging, filling, levees or dikes within the floodway which might raise flood water levels in the F-1 District. Only portions of Novato near Bel Marin Keys have been zoned F-1.

The Secondary Floodway District (F-2) prohibits structures, buildings, leveeing, diking, or filling except within specified encroachment areas, so that each project has capacity to absorb flood water overflow from the primary floodway. The zoning district also requires the dedication of any areas zoned F-1 on the property under review to protect the public from potentially increased flood hazards which would

result from the development of the floodplain in an F-2 zone. The F-2 District also allows for alternate methods of providing flood control facilities equal to original flood retention capacity. Permitted construction in the F-2 zone must comply with drainage requirements and flood control construction standards.

2. Tidelands Zoning

Marin County Code Title 22.77, Tidelands, pertains to land and water areas falling below a specified elevation. The Tidelands Zone prohibits construction, depositing, dumping, filling, excavating, dredging and the placement of piers or other structures on tidelands. Applications may be conditionally approved as long as they meet certain conditions, including that they will not cause or increase the likelihood of flooding in adjoining lands. Rezonings pursuant to the creation of the Tidelands zoning classification include areas along the San Francisco Bay.

3. Bayfront Conservation Zones

The Bayfront Conservation Zoning overlay restricts development activity in environmentally sensitive areas along the shore of the San Francisco Bay. The Bayfront Zone enhances the County's policy of encouraging regulatory flood control by discouraging development in sensitive bay lands.

4. Coastal Zones

Marin County Coastal Zoning specifies development areas, provides for coastal access, protects natural resources, and sets standards for public and private activity in a manner consistent with the California Coastal Act (Chapter 6, Section 3). Coastal zoning governs all development in Pacific Coast communities subject to flooding. Coastal district regulations do not permit construction or significant improvements within a 100-year floodplain in a coastal zone (22.56, Development Requirements, Standards, and Conditions). The zone also specifies setbacks from the ocean for certain areas, in particular the Seadrift portion of Stinson Beach.

E. REGULATION OF HARBORS AND WATERWAYS (DAMS AND WATERCOURSES)

Marin County Code Title 11, Harbors and Waterways, regulates the construction and repair of dams and the diversion or obstruction of watercourses. Section 11.04, Dams, regulates the construction and repair of dams which are smaller that those regulated by the State of California and states that the County Department of Public Works will periodically inspect dams in the unincorporated areas to determine their safety.

Section 11.08, Watercourses, declares that the free and unobstructed flow of every creek is essential to proper drainage and the protection of life and property, and therefore any material which interferes with the unobstructed flow of water constitutes a public nuisance which must be abated.

F. MARIN COUNTY FLOODPLAIN MANAGEMENT

Marin County Ordinance 2710, (adopted on May 11, 1982 and revised July 26, 1988) added Chapter 23.09, Floodplain Management. Marin County Code Section 23.09 (Floodplain Management) does the following:

1. Adopts the Federal Emergency Management Agency Flood Insurance Rate Map and Floodway Boundary Map as the official flood identification maps for unincorporated Marin County.

2. Provides for the development of implementing rules and regulations.

3. Establishes a process for appeals and penalties.

4. Assigns administrative and supervisory responsibilities for the ordinance to the Department of Public Works and authorizes the Department to require compliance bonds at its discretion.

5. Requires permits for any building or construction in, upon, or over any creek, channel, or watercourse.

6. Requires subdivisions to provide for grading and erosion control.

7. Adopts a zoning plan for unincorporated areas based on the County General Plan which establishes regulatory flood control zoning districts.

The Board of Supervisors adopted regulations for the Marin County Floodplain Management Ordinance in Resolution Number 82-161 "Rules and Regulations for Enforcing the Provisions of Marin County Code Chapter 23.09," on May 11, 1982 and revised on July 26, 1988.

Resolution Number 82-161 does the following:

1. Applies regulations to flood hazard areas as shown on FEMA Flood Insurance Rate Map (FIRM) and the Flood Boundary Floodway Map.

2. Requires proposed development within a FIRM designated area to be flood-proofed through design, materials, and construction methods (such as anchoring, flood proofing lower floors, and elevations) to protect the flood-carrying capacity of any of any watercourse.

3. Creates a checklist for evaluating all subdivision and development applications.

4. Adopts construction standards for all new construction and substantial rehabilitation for special flood hazard areas. These standards include anchoring, construction materials and methods, elevations, flood proofing, and the storage of hazardous materials and equipment.

5. Defines floodways as extremely hazardous areas requiring special regulatory attention including the prohibition of encroachments which may increase flood levels, and the establishment of construction standards for new construction and substantial improvement.

6. Identifies Coastal High Hazard Areas. Regulations for the Coastal High Hazard Area require structures to be sited landward of the reach of the mean high tide, prohibit mobile homes, establish construction standards and set requirements for the use of breakaway walls.

The regulations also set out variance and appeal procedures and standards for non-conforming uses.

G. FEDERAL EMERGENCY MANAGEMENT AGENCY RESOURCES

Through the National Flood Insurance Program (NFIP), the Federal Emergency Management Agency (FEMA) provides flood insurance studies and maps to localities for use in land use planning in flood hazard areas. FEMA Flood Insurance Rate Maps (FIRM) identify official floodplains and base flood elevations, the expected surface elevation of a 100-year flood.

The FIRM maps show elevations and flood zones. FEMA additionally supplies Floodway Maps identifying channels which must be kept free of encroachments so that the 100-year flood can be carried without substantial increases in flood heights.

The Federal Emergency Management Agency updated its 1977 flood hazard study in 1984, including a coastal analysis for the community of Stinson Beach. This study describes flood problems, flood protection measures, floodplain management and insurance issues. The study also provides basic information for floodplain management in Marin County. Maps showing flood hazard areas identified by FEMA are available for review at the County Public Works Department.

FEMA also conducted studies for the cities of Belvedere, Corte Madera, Fairfax, Larkspur, Mill Valley, Ross, San Anselmo, Sausalito, Novato, and San Rafael. Marin cities and towns and Marin County Water Conservation and Flood Control District Flood Zones use these studies for their floodplain planning and management.

V. STATUS OF THE 1977 ENVIRONMENTAL HAZARDS ELEMENT

For the most part, Marin County successfully carried out the policies adopted in the 1977 Environmental Hazards Element. Flood control policies and measures enacting them are described below. The policies shown below have been somewhat abbreviated for clarity.

Policy B-3.1 **No public safety structure (such as police and fire stations) should be located in areas subject to tsunamic inundation.** County Code Section 23.09 (Floodplain Management) authorizes the creation of a Coastal High Hazard Area (Resolution Number 82-161, May 11, 1982) which restricts buildings and structures in Coastal Hazard Areas to the landward reach of the mean high tide.

Policy B-3.2 **In locating public safety structure, on-site considerations should be given to the placement of persons within the range of a tsunami. Improvements should be designed to withstand impact from the tsunami and the debris it will carry.** The Floodplain Management Regulations creating Coastal High Hazard Areas apply construction standards for structures landward of the mean high tide line, including requirements for pilings and columns, breakaway walls, and floor elevations so as to withstand "high velocity waters from coastal and tidal inundation or tsunamis".

Policy C-4.1 **Consider the use of floodplain zoning.**

Policy C-4.2 **Promote multiple uses of flood retention lands.**

Policy C-4.3 **Encourage regulatory flood control.** These three sections of the Countywide Plan provide policies underlying Floodplain Zoning (County Code Sections 22.94 and 22.95) and Floodplain Management (County Code Section 23.09). These code sections use floodplain zoning powers to regulate flood hazards. The Floodplain Management ordinance allows for multiple uses of flood retention lands as long as these uses either conform to construction standards or leave floodways and primary flood floodways unobstructed.

Policy C-4.4 **Consider adopting a creek setback ordinance.** The County Planning Department uses the Streamside Conservation policies adopted as part of the Countywide Plan in reviewing development applications, specifying that all structures be set back from "riparian systems" including rivers, streams, and other watercourses. In 1983, Planning Department staff drafted an ordinance to codify these policies into an amendment to Title 24 of the County Code, creating creekside development standards. After hearings before the Board of Supervisors, the Board tabled the ordinance and indicated that Countywide Plan policies provided sufficient direction for implementation. The policies have been applied to a number of development projects throughout the County.

Policy C-4.5 **Reevaluate flood prone areas for changes over time.** The Floodplain Management Ordinance requires site review for all new construction and substantial rehabilitation within the floodplain. Inspections of areas within County Flood Control Zones are conducted periodically by the Department of Public Works. In addition, the Federal Emergency Mangement Act study published in 1986 documents changes in flood conditions in the County.

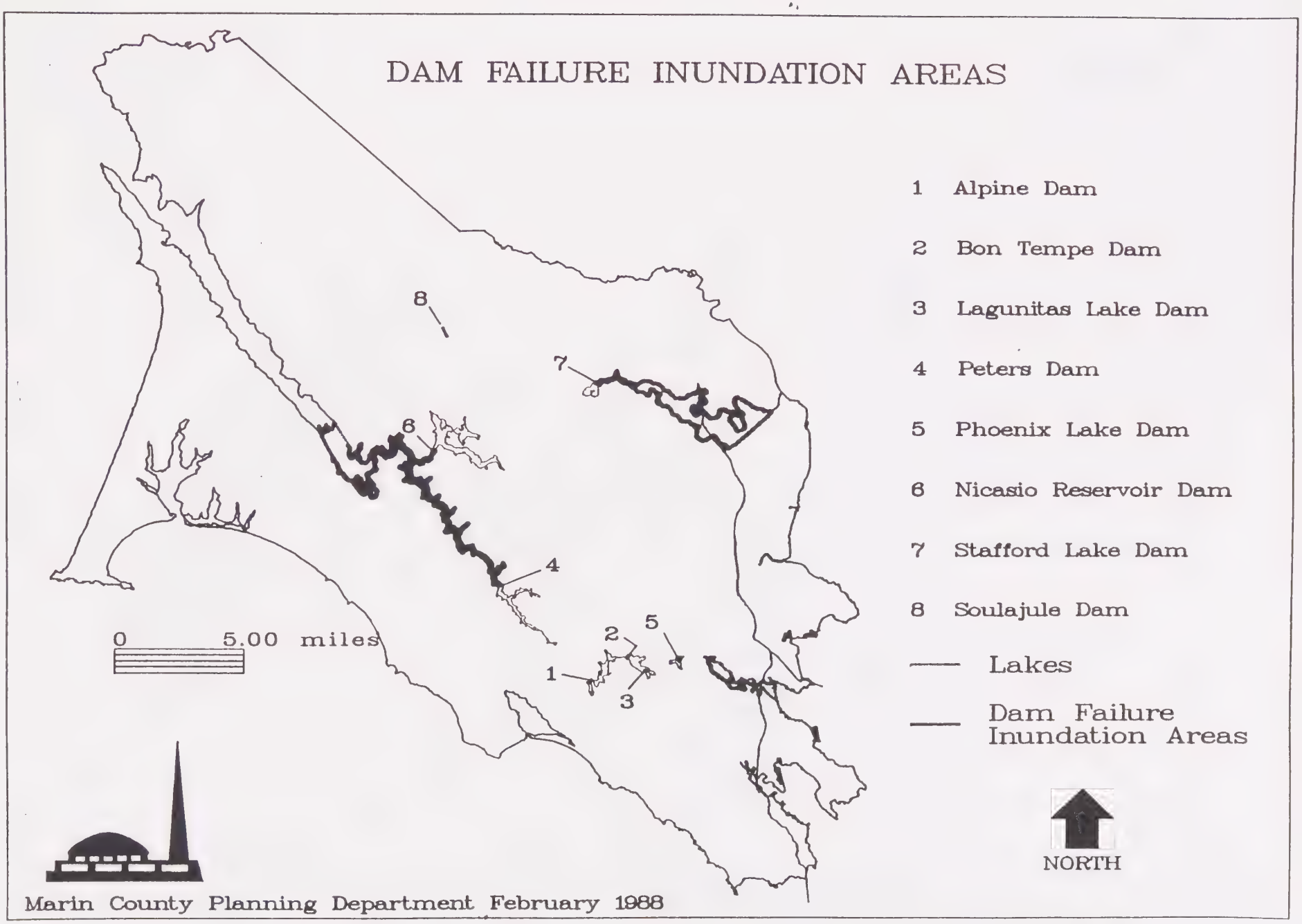
Policy C-4.6 **Insure adequate stream channel capacity to handle flood runoff.** County Code Section 23.09, requires the maintenance of adequate stream channel capacity and the prevention of obstructions to stream channels through prohibitions against development within floodways. Marin

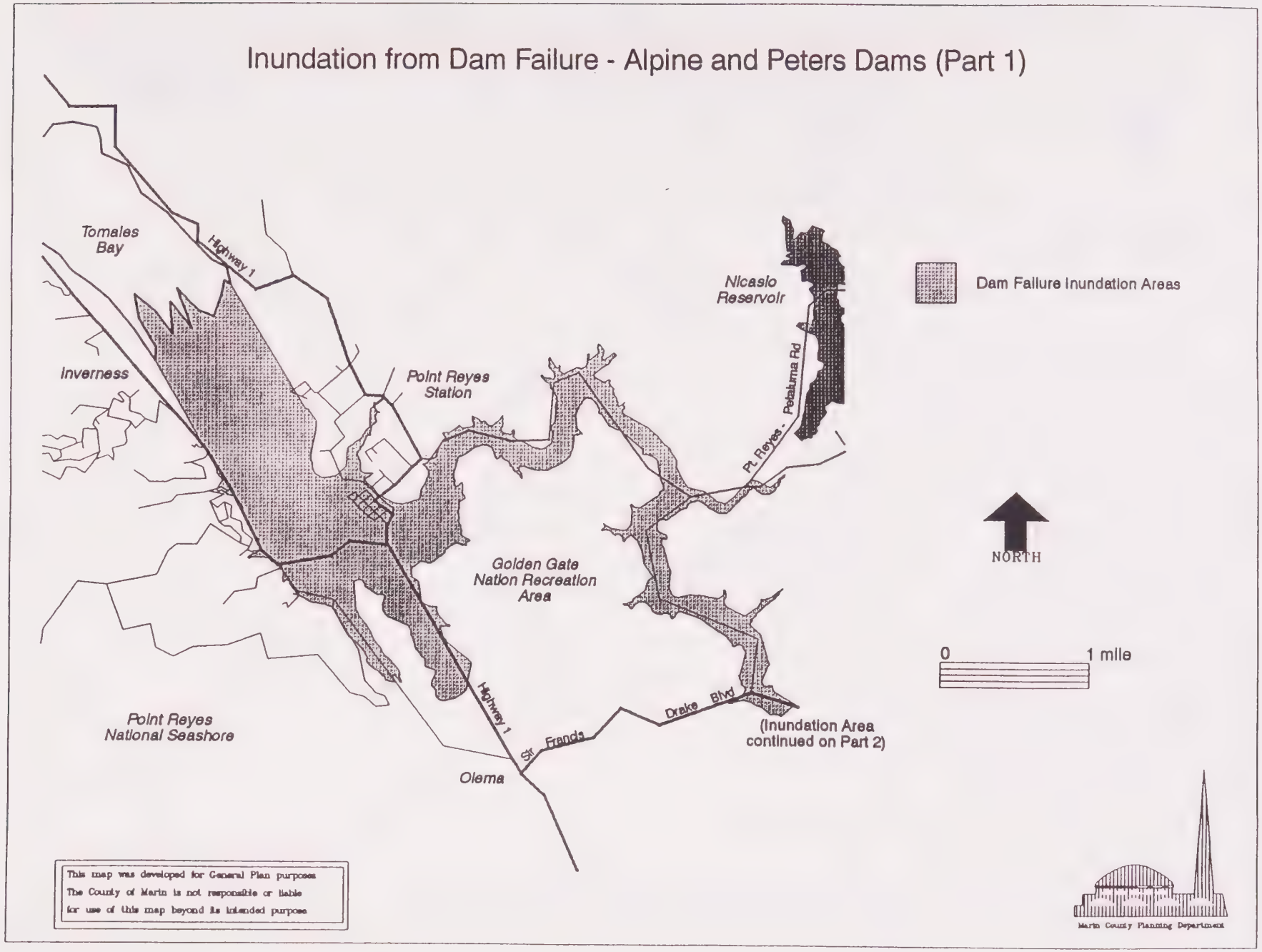
County Code Titles 11 (Watercourse Obstruction), and 22 (Zoning) also prohibit activities which would reduce the capacity of stream channels to handle flood runoff.

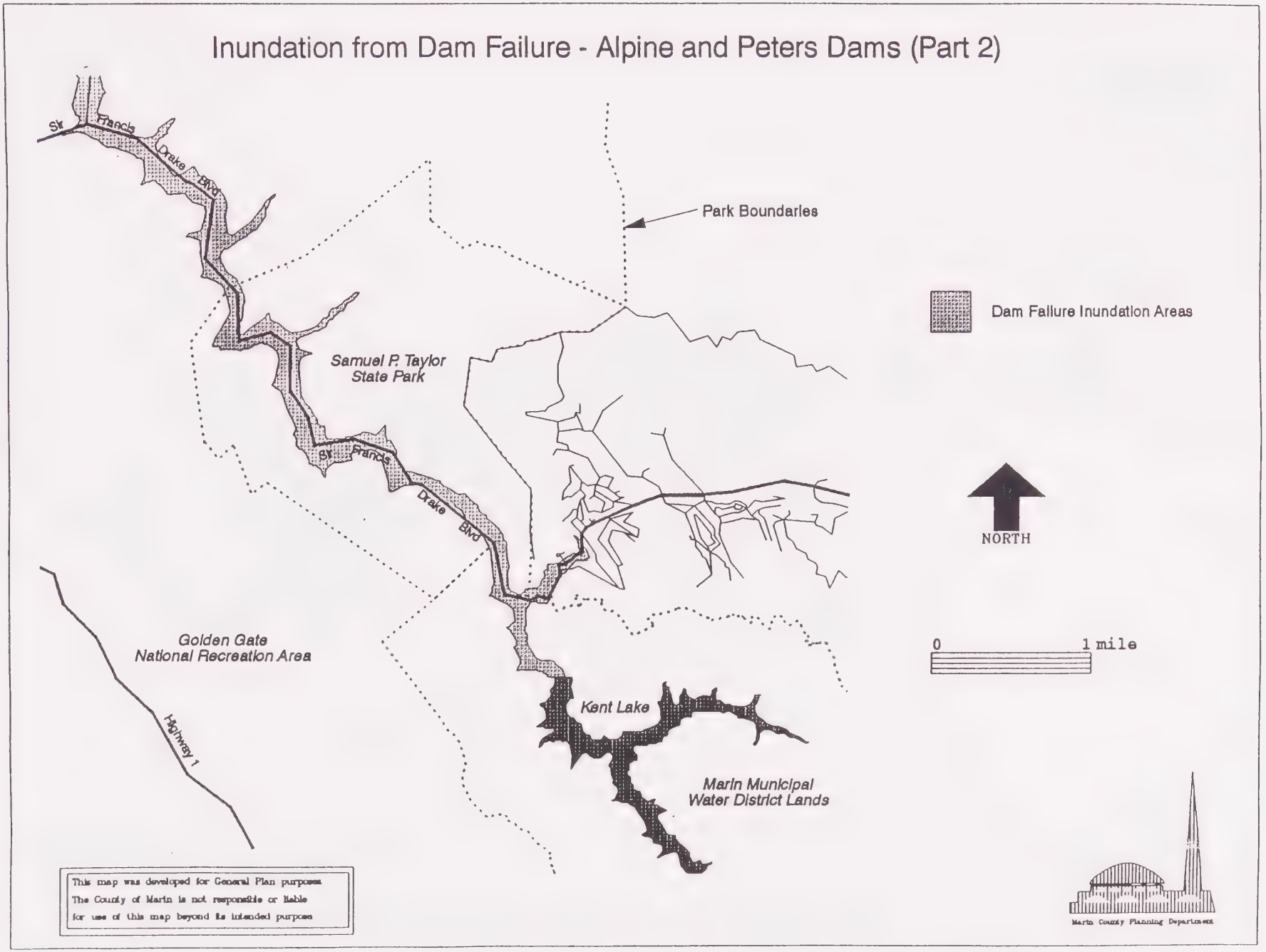
Policy C-5.1 **Dams and levees should be designed and located so as to insure dam safety.** Marin County Code Section 11.04, Dam Construction and Repair, requires the Department of Public Works to inspect dams and approve applications for dam construction and repair to insure public safety.

Policy C-5.2 **Property owners within areas of possible inundation be notified as to the timing and susceptibility to flood hazards.** The "Marin County Multihazard Plan, 1986", prepared by the Office of Emergency Services, provides for warning citizens of a possible dam failure. However, property owners within these areas were not notified about their suceptibility to dam failure after the adoption of the 1977 Environmental Hazards Element.

Appendix 1. Marin County Dam Inundation Areas


DAM FAILURE INUNDATION AREAS
1 Alpine Dam
2 Bon Tempe Dam
3 Lagunitas Lake Dam
4 Peters Dam
5 Phoenix Lake Dam
6 Nicasio Reservoir Dam
7 Stafford Lake Dam
8 Soulajule Dam
Lakes
Dam Failure Inundation Areas
0 5.00 miles
NORTH
Marin County Planning Department February 1988


Inundation from Dam Failure - Alpine and Peters Dams (Part 1)
Tomales Bay
Highway 1
Inverness
Point Reyes Station
Nicasio Reservoir
Pt. Reyes - Petaluma Rd
Golden Gate Nation Recreation Area
Point Reyes National Seashore
Highway 1
Sir Francis Drake Blvd
Olema
(Inundation Area continued on Part 2)
Dam Failure Inundation Areas
NORTH
0
1 mile
This map was developed for General Plan purposes.
The County of Marin is not responsible or liable
for use of this map beyond its intended purpose
Marin County Planning Department


Inundation from Dam Failure - Alpine and Peters Dams (Part 2)
St Francis Drake Blvd
Park Boundaries
Dam Failure Inundation Areas
Samuel P. Taylor State Park
St Francis Drake Blvd
NORTH
0
1 mile
Golden Gate National Recreation Area
Highway 1
Kent Lake
Marin Municipal Water District Lands
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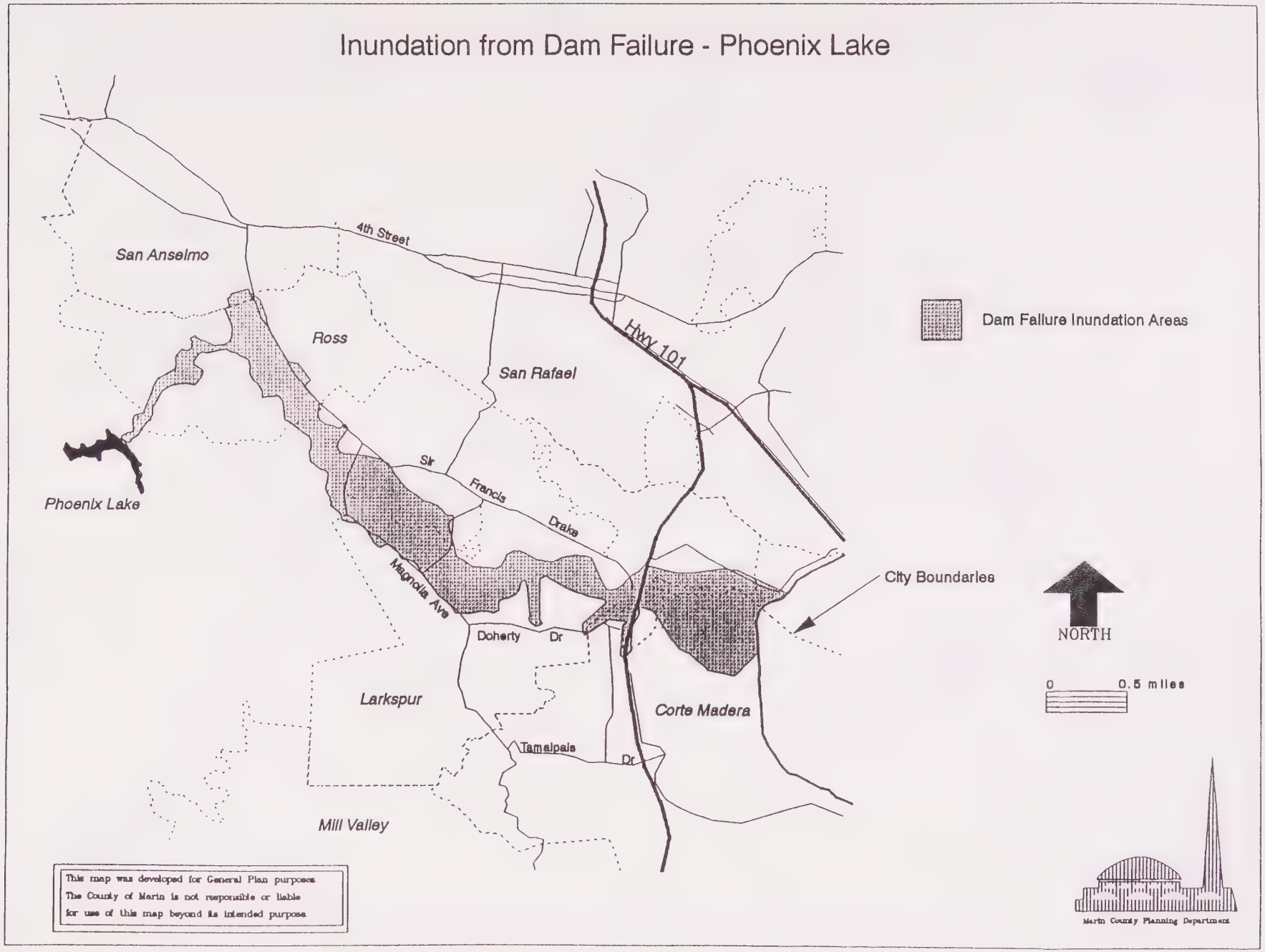
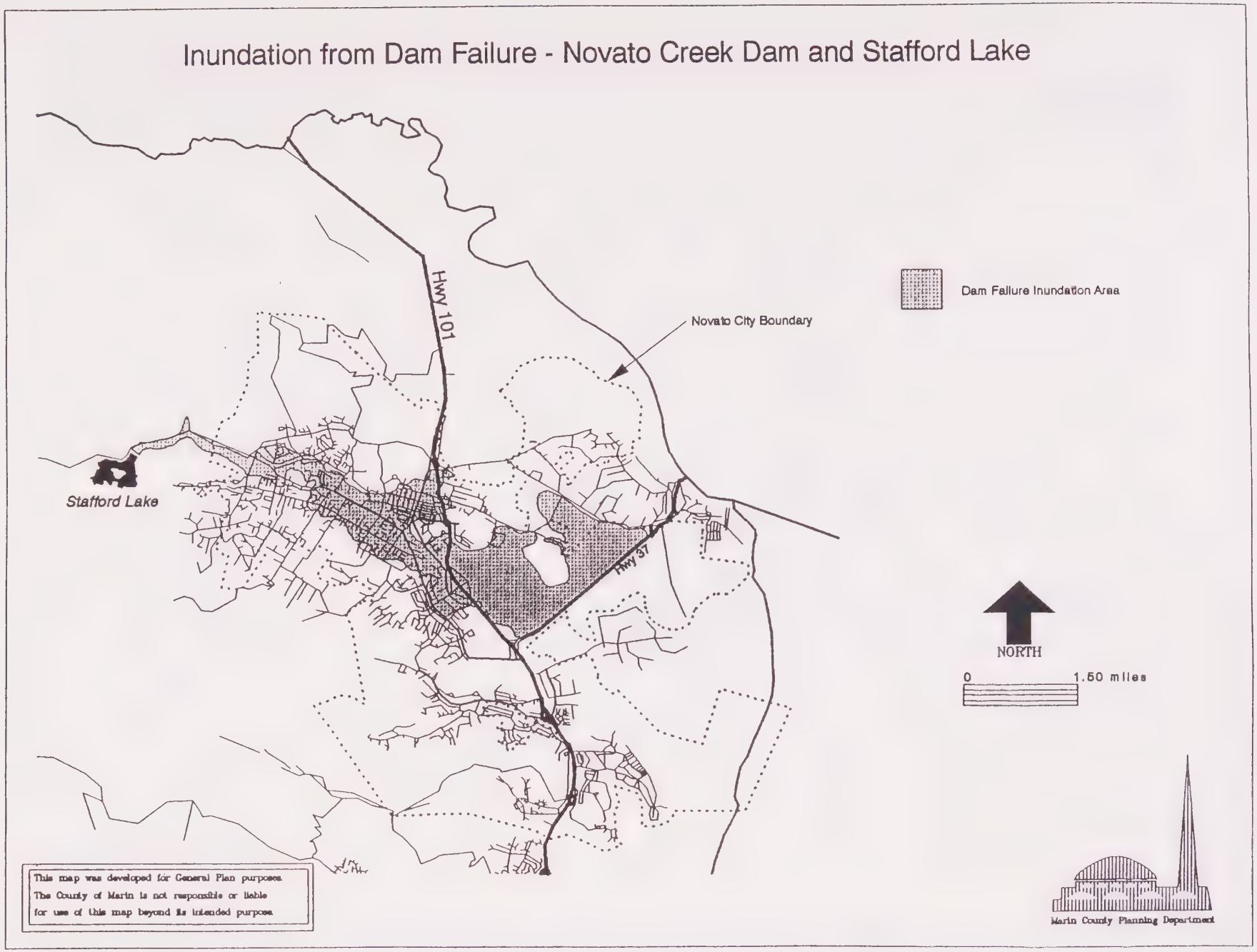
Marin County Planning Department


Inundation from Dam Failure - Phoenix Lake
San Anselmo
4th Street
Ross
San Rafael
Hwy 101
Sir
Francis
Drake
Phoenix Lake
Magnolia Ave
Doherty
Dr
Larkspur
Corte Madera
Tamalpais
Dr
Mill Valley
Dam Failure Inundation Areas
City Boundaries
NORTH
0
0.5 miles
This map was developed for General Plan purposes.
The County of Marin is not responsible or liable
for use of this map beyond its intended purpose.
Marin County Planning Department

Inundation from Dam Failure - Nicasio Reservoir


Inundation from Dam Failure - Novato Creek Dam and Stafford Lake
Hwy 101
Novato City Boundary
Dam Failure Inundation Area
Stafford Lake
Hwy 37
NORTH
0
1.50 miles
This map was developed for General Plan purposes.
The County of Marin is not responsible or liable
for use of this map beyond its intended purpose.
Marin County Planning Department

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Appendix 3. List of People and Agencies Contacted

Carl Baumsteiger, Marin Municipal Water District

Jeff Blanchfield, Bay Conservation and Development Commission

Richard Carlsen, Deputy Director, Marin County Department of Public Works

David Cobb, Federal Emergency Management Agency

Bill Doyle, Marin County Department of Emergency Services

Scott Hochstrasser, Principal Planner, Marin County Planning Department

Chuck Murphy, Marin County Department of Public Works

North Marin Water District

Romaine Repair, Marin County Department of Public Works

David Zaketi, California Department of Emergency Services